



Corrosion Preventing Characteristics of Military Hydraulic Fluids, Part II

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Presentation Content

- Introduction and Brief History
- Sample Identification
- Laboratory Corrosion Tests and Parameters
 - Rust Preventing Characteristics ASTM D 665
 - Corrosiveness to Copper ASTM D 130
 - Corrosiveness and Oxidative Stability
ASTM D 4636
- Conclusion



Introduction and Brief History

- Definition of Corrosion
- Corrosion Protection is based on system design and operational environment
 - Military Ground Vehicles
 - Military Aviation Vehicles



Sample Identification

Hydraulic Fluids

- MIL-PRF-5606 – Petroleum Based
- MIL-PRF-6083 – Petroleum Based
- MIL-PRF-46170 – Synthetic, Fire Resistant, Rust Inhibited
- MIL-PRF-83282 – Synthetic, Fire Resistant
- MIL-PRF-87257 – Synthetic, Fire Resistant, Aircraft & Missile



Sample Identification cont...

Internal Combustion Engine Oils

- MIL-PRF-2104 – 10W and 15W40
- MIL-PRF-21260 – 10W and 15W40: Break-In
- MIL-PRF-46167 – 0W30



Laboratory Corrosion Tests

- Part I Included:
 - Rust Prevention ASTM D 665 Procedure A
 - Humidity Cabinet ASTM D 1748
 - Galvanic Corrosion ASTM D 6547
- Current Paper tested:
 - Rust Prevention ASTM D 665 Procedure B
 - Copper Strip Test ASTM D 130
 - Corrosiveness and Oxidation Stability ASTM D 4636



Rust Preventing Test

- Comparison of distilled water versus sea salt water

	Sample	Distilled Water	Sea Water
Internal Combustion Engine Oils	MIL-PRF-21260 15W40	Pass	Pass
	MIL-PRF-21260 10W	Pass	Pass
	MIL-PRF-46167	Pass	Pass
	MIL-PRF-2104 15W40	Pass	Pass
	MIL-PRF-2104 10W	Pass	Pass
Army Hydraulic Fluids	MIL-PRF-46170	Pass	Pass
	MIL-PRF-6083	Pass	Pass
Air Force Hydraulic Fluids	MIL-PRF-87257	Pass	Fail
	MIL-PRF-5606	Pass	Fail
Navy Hydraulic Fluid	MIL-PRF-83282	Pass	Fail



Rust Preventing Test

- Specimens after exposure to sea salt water



Figure 1: MIL-PRF-46170



Figure 2: MIL-PRF-87257



Humidity Cabinet

Engine Oils	MIL-PRF-21260 15W40	Pass
	MIL-PRF-21260 10W	Pass
	MIL-PRF-46167	Pass
	MIL-PRF-2104 15W40	Fail
	MIL-PRF-2104 10W	Fail
Army Hydraulic Fluids	MIL-PRF-46170	Pass
	MIL-PRF-6083	Pass
Air Force Hydraulic Fluids	MIL-PRF-87257	Fail
	MIL-PRF-5606	Fail
Navy Hydraulic Fluid	MIL-PRF-83282	Fail



Galvanic Corrosion

Engine Oils	MIL-PRF-21260 15W40	Pass
	MIL-PRF-21260 10W	Pass
	MIL-PRF-46167	Pass
	MIL-PRF-2104 15W40	Pass
	MIL-PRF-2104 10W	Pass
Army Hydraulic Fluids	MIL-PRF-46170	Pass
	MIL-PRF-6083	Pass
Air Force Hydraulic Fluids	MIL-PRF-87257	Pass
	MIL-PRF-5606	Pass
Navy Hydraulic Fluid	MIL-PRF-83282	Pass



Copper Corrosion Test

	Sample	Strip 1	Strip 2	pass/fail
Engine Oils	MIL-PRF-21260 15W40	4b	4b	Fail
	MIL-PRF-21260 10W	4b	4b	Fail
	MIL-PRF-46167	1b	1b	Pass
	MIL-PRF-2104 15W40	1b	1b	Pass
	MIL-PRF-2104 10W	2c	3a	Pass
Army Hydraulic Fluid	MIL-PRF-46170	1b	1b	Pass
	MIL-PRF-6083	1a	1a	Pass
Air Force Hydraulic Fluid	MIL-PRF-87257	1b	1b	Pass
	MIL-PRF-5606	1a	1a	Pass
Navy HF	MIL-PRF-83282	1b	1b	Pass



Copper Corrosion Test



Figure 3: MIL-PRF-46170

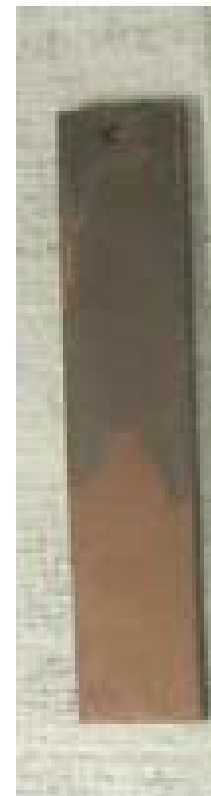


Figure 4: MIL-PRF-21260



Corrosiveness & Oxidation Stability

- Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Lubricants, and Other Highly Refined Oils
- Metals Used:
 - Aluminum
 - Cadmium
 - Copper
 - Magnesium
 - Steel



Corrosiveness & Oxidation Stability

	Sample	At 121°C	At 135°C
Engine Oils	MIL-PRF-21260 15W40	Fail	Fail
	MIL-PRF-21260 10W	Fail	Fail
	MIL-PRF-46167	Pass	Fail
	MIL-PRF-2104 15W40	Pass	Pass
	MIL-PRF-2104 10W	Pass	Fail
Army Hydraulic Fluids	MIL-PRF-46170	Pass	Fail
	MIL-PRF-6083	Pass	Fail
Air Force Hydraulic Fluids	MIL-PRF-87257	Pass	Pass
	MIL-PRF-5606	Pass	Pass
Navy Hydraulic Fluid	MIL-PRF-83282	Pass	Pass



Corrosiveness & Oxidation Stability

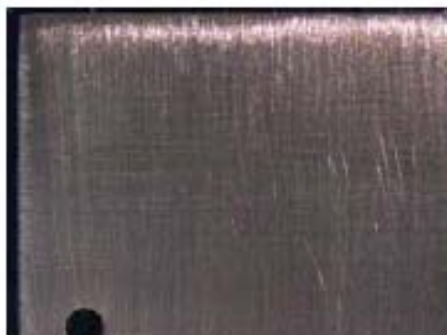


Figure 6: Freshly Polished Copper



Figure 7: MIL-PRF-21260 15W40 (Copper - 3b corrosion at 135°C)



Figure 8: Freshly Polished Cadmium



Figure 9: MIL-PRF-2104 10W (Cadmium - tan colored at 135°C)



Figure 10: MIL-PRF-6083 (Cadmium - corrosion at 135°C)



Figure 11: MIL-PRF-46170 (Cadmium - corrosion at 135°C)



Conclusions

Currently there is not a military hydraulic fluid that is capable of protecting Army equipment at elevated temperatures and varying conditions.

In the future, the Army will seek to develop a synthetic, fire resistant hydraulic fluid formulated with a corrosion / rust inhibitor that is thermally stable at elevated temperatures.



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Questions?

Thank You